



TECHNICAL REPORT: MARKETING STUDY OF COLORADO
FENCE POSTS

Thomas C. Crews

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TECHNICAL REPORT

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THOMAS C. CREWS

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COLORADO STATE UNIVERSITY

TECHNICAL REPORT

MARKETING STUDY OF COLORADO

FENCE POSTS

by

THOMAS C. CREWS

PREPARED FOR U. S. DEPARTMENT OF

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WOOD UTILIZATION LABORATORY

DEPARTMENT OF FOREST AND WOOD SCIENCES
COLLEGE OF FORESTRY AND NATURAL RESOURCES
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ABSTRACT

MARKETING STUDY OF COLORADO FENCE POSTS

The objective of this study is to determine the primary market characteristics of fence posts in Colorado. Private farm, state school, and most federal lands were sampled using the mail survey method. About 97 percent of the total land area in Colorado is represented in the sample.

There are approximately 99.6 million posts in service in Colorado. This excludes those posts used in the 16,000 miles of commercial and residential fencing. Indications are that more wood posts are in service on private farm lands while a higher percentage of steel posts are used on federal lands. Wood posts are preferred over steel posts in most cases because they are stronger, they hold in the soil better, and are less expensive. The three main reasons given by those preferring steel posts over wood posts are ease of installation, ease of maintenance, and nicer appearance.

Wood represents approximately 81 percent of all posts in service. At least 86.5 percent of these are treated preservatively or made from decay resistant species. There is an annual demand for 3.2 million wood posts in addition to those needed for 913 miles of commercial and residential fencing. The species most commonly treated and used for fence posts are southern yellow pine, lodgepole pine, and ponderosa pine. Those commonly used for untreated posts include eastern redcedar, western redcedar, Rocky Mountain juniper, and Utah juniper.

This study clearly shows wood posts are competitive in all respects to steel posts and, while southern yellow pine posts are commonly

used in Colorado, preservatively treated lodgepole pine and ponderosa pine make excellent posts.

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CHAPTER I

INTRODUCTION

One of the most serious problems confronting the proper management of the public and private timbered resource in Colorado is the lack of a market for trees of poletimber size.¹ The state's timber industry is primarily a sawmill industry with very little integrated processing. Data in the following tabulation show the product types and quantities produced by the forest products industry in 1962 (18).

	Thousand cubic feet
SAWLOGS	31,563
MINE TIMBERS	1,411
FUEL WOOD	702
POLES	482
POSTS	329
MISCELLANEOUS INDUSTRIAL WOOD	1,946

As is shown, the preponderance of the cut is sawlogs. Less than 14 percent is for other products and only about one percent is being cut for posts.

Desirable qualities of the wood, as well as the large untapped volume, favor industrial development of the timber resource. Slow growth rates combined with satisfactory wood characteristics result in exceptionally even-textured wood with a high strength-to-weight ratio (18). If suitable markets can be developed, there are excellent opportunities for integrated operations producing lumber, plywood, wood composition board, round timbers, and other wood products.

¹A poletimber tree is defined as a live tree of commercial species, 5.0 to 10.9 inches d.b.h., free of rot and having the likelihood of growing into a sawtimber tree.

This management problem is particularly pertinent to lodgepole pine because of the way it reproduces, resulting in vast acreages of poletimber size stands. There are approximately 2.1 million acres of lodgepole pine which account for 17 percent of the total commercial forest land in Colorado.¹ Of this area, 1.3 million acres are of poletimber size. In the remaining 800,000 acres of lodgepole pine sawtimber stands, poletimber trees comprise about one-half the cubic foot volume (18). Huge portions of the acreage have experienced growth reduction due to heavy infestations of dwarf mistletoe and stagnation due to overcrowding. This growth reduction is the principal reason why many thousands of acres produce lodgepole pine no larger than pole size. Many of these trees are left unused in sawlog operations because of the lack of a market. In fact, present national forest practice is to destroy these residual trees.

This problem also applies to ponderosa pine because of its commercial importance in Colorado, and because of its similarity to southern yellow pine (which is widely used for fence posts) with respect to sapwood thickness and treatability (16). There are 2.3 million acres of ponderosa pine which account for 19 percent of the total commercial forest land in Colorado. About 550,000 acres of this area are of poletimber size (18). Heavy cutting in the past has reduced tree size in many areas. Ponderosa pine has been cut largely for lumber but in integrated operations could well be used for other products including posts and poles.

¹Commercial forest land is that which is (a) producing, or is physically capable of producing, usable crops of wood; (b) economically available now or prospectively; (c) not withdrawn from timber utilization.

This report is primarily concerned with the utilization of these two species for posts. It shows the major market characteristics in fencing with respect to number of posts in use, percentage of wood posts versus steel posts, preference of these two posts, reasons for post type selection, percentage of treated wood posts, and other factors relevant to fencing. The report makes projections on the future market potential for fence posts, and develops some of the major requirements that must be met by fence post producers to capitalize on the existing and potential market. It also discusses reasons for using wood posts and presents facts pertaining to cost, strength, maintenance, durability, and installation of posts.

CHAPTER II

SAMPLING PROCEDURE

The population was sampled using the mail survey method. This involved mailing a questionnaire to potential respondents and having them return the completed form by mail.

Because inflexibility is a major limitation of this sampling method, an important part of the project was constructing an effective questionnaire. The three primary concepts used in designing the questionnaire were: 1) to develop one of interest to the respondent; 2) to obtain short answers to short questions; and 3) to secure the desired information. Before the questionnaire was mailed it was tested on a selected group of farmers, and as a result, some minor revisions were made. In testing this questionnaire, it was found that 1) the questions were in proper order and easy to understand; 2) they were not too difficult if reasonable estimates were allowed; and 3) it took an average of 20 minutes to complete.

The sample included 96.7 percent of the total land area in Colorado. The land areas sampled included 38,258,626 acres of private farm land, 2,781,987 acres of state school land, and 23,349,382 acres of federal land administered by the U. S. Forest Service, Bureau of Land Management, National Park Service, and the Bureau of Indian Affairs (10, 21). The various land classifications sampled are shown in Table 1. Those land classifications not sampled included miscellaneous and industrial land, town and city lots, railroad rights of way, military reservations, miscellaneous state lands (other than state school lands), municipal and county lands, and Bureau of Land Management land outside the grazing districts.

TABLE 1. AREAS SAMPLED BY LAND CLASSIFICATION.

LAND CLASSIFICATION	AREA (acres)	AREA (%)	AREA SAMPLED (acres)	SAMPLE (%)
Private Farm Land & State School Land ¹	41,040,613	61.7	805,714	2.0
Federal Land				
National Forest Lands	13,712,352	20.6	12,701,091	92.6
BLM Lands ²	7,733,742	11.6	7,733,742	100.0
Indian Lands	751,885	1.1	751,885	100.0
National Grasslands	612,036	0.9	612,036	100.0
NPS Lands ³	539,367	0.8	228,995	42.5
Totals	64,389,995	96.7	22,833,463	

¹The sampling of state school lands was included with that of the private farm lands because according to Anthony Sabatini, Administrative Officer, State Board of Land Commissioners, in a letter dated November 6, 1967, "... fencing on state school lands is the responsibility of our lessees under the terms of our leases."

²Bureau of Land Management.

³National Park Service.

The federal lands were sampled by mailing questionnaires to ten national forests, two national grasslands, five BLM grazing districts, seven national parks and monuments, and the Consolidated Ute Agency which administers the Indian lands in Colorado. A copy of the questionnaire used to sample federal lands is shown in Appendix A.

The private farm lands were sampled by selecting names of farmers from lists located in the individual county Agricultural Stabilization and Conservation Service (ASCS) offices. Random selection of names from this finite population was made on the basis of number of farms per county.¹ The sample was not stratified in any way. A copy of the

¹The sample design for each county was constructed using a table of random sampling numbers (15). Sampling of the private farm lands was accomplished using each county as a sub-population because the individual counties had the most complete lists of the farmer population.

questionnaire used to sample the private farm land is shown in Appendix B. Of the 63 counties in Colorado, 54 were included in the sample. Clear Creek, Denver, Gilpin, and San Juan Counties were not sampled because there are no ASCS offices in these counties. They have about .05 percent of the total farm land in Colorado. Costilla, Kit Carson, Phillips, Sedgwick, and Yuma Counties were not sampled because of lack of time.

Four hundred seventy of the 2,040 questionnaires mailed were sent back for a 23 percent return. Of those returned, 374 listed a total of 805,714 acres which amounts to 1.96 percent of the total private farm land area; hence a 1.96 percent sample. The average size farm in the sample was 1,365 acres owned and 790 acres rented or leased. The average size farm in Colorado is 1,284 acres (21).

CHAPTER III

RESULTS

Results pertaining to such fence post characteristics as demand, number, species, sources, and kinds are presented in this chapter.

1. There are approximately 99.6 million posts in service in Colorado. This figure is derived from Table 2 to include the total land area in Colorado (66,485,760 acres) less that classified as miscellaneous and industrial land, and town and city lots (458,218 acres). The tabulation of the number of posts by land classification is shown in Table 2.

TABLE 2. TOTAL NUMBER OF FENCE POSTS CURRENTLY IN SERVICE.

LAND CLASSIFICATION	POSTS (no./acre)	AREA (acres)	TOTAL POSTS (no.)
Private Farm Land & State School Land			
Less than 499 Acres	8.7903	3,040,863	26,730,098
500-999 Acres	3.6255	3,307,468	11,991,225
1,000-1,999 Acres	2.0588	5,744,443	11,826,659
Greater than 2,000 Acres	1.4509	28,947,839	42,000,420
Federal Land			
National Forest Lands	0.1058	13,712,352	1,450,767
BLM Lands	0.2793	7,733,742	2,160,034
Indian Lands	0.2371	751,885	178,272
National Grasslands	1.0731	612,036	656,776
NPS Lands	0.3378	<u>539,367</u>	<u>182,198</u>
Totals Based on Area Sampled		64,389,995	97,176,449
Totals Expanded to Include 66,027,542 Acres		66,027,542	99,647,811

On those land areas classified as miscellaneous and industrial land, and town and city lots, the fencing is measured in linear feet

because it is generally sold on that basis. In an unpublished study by DeSylva, et al. (11) in the Fort Collins area, it is reported there are 831,850 linear feet of fencing on their sample of commercial land (miscellaneous and industrial land), and 837,992 linear feet of fencing on their sample of residential land (town and city lots). Data in Table 3 show there are more than 84.6 million linear feet of fencing in service in commercial and residential areas.

TABLE 3. DISTRIBUTION OF FENCING IN SERVICE IN INDUSTRIAL AND RESIDENTIAL AREAS.

LAND CLASSIFICATION	SAMPLE			EXPANDED	
	AREA (acres)	SAMPLE (%)	FENCING (ft.)	AREA (acres)	FENCING (ft.)
Miscellaneous and Industrial Land	3,699	1.9	831,850	195,130	43,881,830
Town and City Lots	<u>5,408</u>	2.1	<u>837,992</u>	<u>263,088</u>	<u>40,766,575</u>
Totals	9,107		1,669,842	458,218	84,648,575

2. Data in Table 4 show the percentages of wood and steel posts in service within each land classification. About 91 percent of the respondents on the private farm lands reported they used a higher percentage of wood posts than steel. Four percent indicated they used no fencing. This study shows there are more steel posts in service on the national forest, BLM, and NPS lands while there is a higher percentage of wood posts used on private farm and state school lands. Recognizing there are many factors to be considered, it is noted the Montana Highway Department not only uses wood posts because of the low initial cost and low maintenance cost but also because they consider, "... that wood is

a very important industry in Montana and it pays us to use a local product" (14).

TABLE 4. SAMPLE BREAKDOWN OF POSTS CURRENTLY
IN SERVICE WITHIN EACH LAND CLASS.

LAND CLASSIFICATION	AREA SAMPLED (acres)	WOOD POSTS		STEEL POSTS	
		number	percent	number	percent
Private Farm Land & State School Land	805,714	1,210,608	84.1	228,141	15.9
Federal Land					
National Forest Lands	12,701,091	609,385	45.3	734,359	54.7
BLM Lands	7,733,742	274,805	12.7	1,885,579	87.3
Indian Lands	751,885	142,636	80.0	35,659	20.0
National Grasslands	612,036	489,684	74.6	167,096	25.4
NPS Lands	228,995	887	1.1	76,469	98.9
Totals	22,833,463	2,728,005		3,127,303	

3. During the next five years there will be a need for approximately 16.2 million wood posts in Colorado. This includes those needed for replacement and new fencing. This figure is based on Table 5 which includes the total land area in Colorado less that classified as miscellaneous and industrial land, and town and city lots. The tabulation of future needs for posts by land classification is also shown in Table 5.

DeSylva, et al. (11) reported an annual demand for 46,776 linear feet of fencing on their sample of residential land. This included four classifications of fencing: wood, wood-metal, metal, and masonry. They showed an annual demand for 48,263 linear feet of fencing on the commercial land. This included five classifications of fencing: wood, wood-metal, metal, masonry, and other. Data in Table 6 indicate there will be an annual demand for about 4.8 million linear feet of fencing in commercial and residential areas.

TABLE 5. FUTURE NEEDS FOR POSTS FOR REPLACEMENT AND NEW FENCING.

LAND CLASSIFICATION	ANNUAL NEEDS		PROJECTED 5-YEAR NEEDS		AREA (acres)
	Wood	Steel	Wood	Steel	
Private Farm Land & State School Land	3,125,101	1,224,075	15,625,507	6,120,375	41,040,613
Federal Land					
National Forest Lands	13,063	42,429	65,315	212,145	13,712,352
BLM Lands	13,282	131,796	66,410	658,980	7,733,742
Indian Lands	9,580	1,900	47,900	9,500	751,885
National Grasslands	3,500	15,100	17,500	75,500	612,036
NPS Lands	106	389	530	1,945	539,367
Totals Based on Area Sampled	3,164,632	1,415,689	15,823,162	7,078,445	64,389,995
Totals Expanded to Include 66,027,542 Acres	3,245,114	1,451,692	16,225,572	7,258,462	66,027,542

TABLE 6. ANNUAL DEMAND FOR FENCING IN INDUSTRIAL AND RESIDENTIAL AREAS.

LAND CLASSIFICATION	SAMPLE			EXPANDED	
	AREA (acres)	SAMPLE (%)	FENCING (ft.)	AREA (acres)	FENCING (ft.)
Miscellaneous and Industrial Land	3,699	1.9	48,263	195,130	2,545,974
Town and City Lots	<u>5,408</u>	2.1	<u>46,776</u>	<u>263,088</u>	<u>2,275,556</u>
Totals	9,107		95,039	458,218	4,821,530

4. The primary sources of posts are shown in Table 7. An interesting observation is that 20 percent of the respondents on the private farm land sample cut all their own wood posts. An additional 15.5 percent indicated they cut a portion of the wood posts they use.

5. The species most commonly used for posts on the federal lands are southern yellow pine, lodgepole pine, ponderosa pine (creosote and pentachlorophenol treated), and Utah and Rocky Mountain juniper (untreated). The same may be true of the private farm lands, but this is difficult to determine because of the many different answers received. Appendix C lists the various responses to the question concerning the kinds of wood used for posts. It also indicates the probable species and the percentage of each.

6. Most wood posts are pressure treated under recognized specifications of the American Wood Preservers Association or the federal government (6). Since, however, treated wood posts are widely used on farms, they are sometimes treated there. About 20 percent of the respondents reported they treated some or all their posts using the soak or dip method. About two-thirds indicated they used pentachlorophenol

(penta) while the remaining one-third used creosote.

TABLE 7. SOURCES OF POSTS WITHIN EACH LAND CLASS.

LAND CLASSIFICATION	WOOD	STEEL
Private Farm Land & State School Land	Retail Suppliers 60% ¹ Cut Their Own 20% Truckers or Out-of-State 12% Miscellaneous 8%	Retail Suppliers 96.5% ¹ Miscellaneous 3.5%
Federal Land		
National Forest Lands	Retail Suppliers Treating Plants Local Contractors	General Services Administration (GSA)
BLM Lands	Retail Suppliers Treating Plants GSA BLM Lands	GSA CF&I U. S. Steel
Indian Lands	Reservations	GSA
National Grasslands	Retail Suppliers Wholesale Suppliers	GSA
NPS Lands	Retail Suppliers	GSA Retail Suppliers

¹The percentage indicated is the portion of the respondents that obtained their posts from each source listed. There are no meaningful percentages that can be applied to those sources listed under the federal land. They are simply the primary sources from which posts are obtained.

Blew (7) reports properly seasoned wood that is easy to treat will absorb enough preservative, and will be sufficiently well penetrated during the cold soaking treatment to provide a high degree of protection from decay and termites. Treatment by cold soaking will provide more satisfactory results than those obtained by short dipping treatments. For round posts of easily treated woods, a soaking period of 48 hours produces good penetration. Ponderosa pine and lodgepole pine are

both classed as woods with fair to good retention and sapwood penetration after a soaking period of 48 hours or longer.

There are no short cuts or miracles in wood preservation and the user can expect to gain protection commensurate with the effort, expense, and thoroughness involved in making the treatment (6).

7. The question of what kinds of fence posts were preferred and for what reasons was directed to the private land owner. The same criteria were listed on the questionnaire for both wood and steel posts (See Appendix B). No instructions were provided the respondents to rank the criteria in order of preference. Most respondents listed two or more reasons for their preference for both wood and steel posts. Twenty three different reasons were given for the preference of wood and 17 reasons were given for the preference of steel. As expected from a question of this type, a reason that ranked high for the preference of wood rated low for steel, and vice versa (See Table 8).

TABLE 8. COMPARISON OF REASONS FOR PREFERRING WOOD POSTS AND STEEL POSTS.

CRITERIA	PREFERENCE FOR WOOD		PREFERENCE FOR STEEL	
	NUMBER	PERCENT	NUMBER	PERCENT
More Strength	203	21	21	2
Ability to Hold in the Soil	197	20	26	3
Less Expensive	186	19	51	5
Suitability for the Job	159	17	119	13
More Durable	72	8	82	9
Ease of Maintenance	45	5	176	19
Nicer Appearance	29	3	109	12
Ease of Installation	14	1	289	31
Use as Corner Posts	23	2	---	--
Use as Corral Posts	8	1	---	--
Will Not Burn	---	--	23	2
Temporary Fencing	---	--	20	2
Miscellaneous	<u>30</u>	<u>3</u>	<u>24</u>	<u>2</u>
Totals	966	100	940	100

Wood is preferred primarily because of its superior strength (21 percent), its ability to hold in the soil (20 percent), and its lower cost (19 percent). These three criteria were listed also as a preference for steel, but only on two, three, and five percent of the questionnaires, respectively. Steel is preferred principally because of the ease of installation (31 percent), ease of maintenance (19 percent), and nicer appearance (12 percent). These same three reasons again were listed as a preference for wood, but only on one, five, and three percent of the questionnaires, respectively.

Summarily, 16 percent of the respondents prefer wood posts, ten percent prefer steel posts, and 74 percent prefer a combination of the two. This simply indicates wood posts are preferred for some jobs and steel posts for others. Data in Table 8 further support this statement by showing 17 percent prefer wood posts because of its suitability for the job, and 13 percent prefer steel for the same reason.

8. The major requirements that should be met by fence post producers to fully capitalize on the existing potential market are:

1) Wood posts should be either naturally decay resistant or treated to increase their life expectancy. This study indicated that at least 86.5 percent of all wood posts in service in Colorado belong in this category.

2) Fence post producers should make the consumer aware of the following facts (See Chapter IV):

(a) Mechanically driven wood posts are competitive with machine driven steel when considering the rate, ease, and economics of installation.

(b) Properly treated wood posts are relatively maintenance free.

(c) Properly treated wood posts are durable and will last 25 years or longer.

(d) The initial cost of comparable wood posts is less than that of steel posts.

(e) Wood posts will hold in the soil better than steel posts.

(f) Properly treated wood posts possess a high degree of fire resistance.

(g) Properly treated lodgepole pine and ponderosa pine make excellent fence posts when considering cost, strength, maintenance, durability, and ease of installation.

9. The following three tables contain miscellaneous information collected during the course of the study.

Table 9 shows the amount of fencing that borders various kinds of roads and indicates, as expected, more fencing along county roads than state or federal highways.

Table 10 shows the primary uses of fencing on federal lands and reveals that most fencing is used for boundary delineation.

Table 11 categorizes the different types of fences on federal lands and shows the vast majority of this fencing is barbed wire.

TABLE 9. DISTRIBUTION OF FENCING BORDERING FEDERAL, STATE, AND COUNTY ROADS.

LAND CLASSIFICATION	U.S. HIGHWAYS (%)	STATE HIGHWAYS (%)	COUNTY ROADS (%)	SAMPLE	
				FENCE (mi.)	AREA (acres)
Private Farm Land & State School Land	2.6	2.9	22.4	4,914	805,714
Federal Land					
Forest Service Lands	1.2	1.6	4.7	4,192	12,701,091
BLM Lands	1.3	2.1	3.5	6,751	7,733,742
Indian Lands	1.9	3.8	7.4	547	751,885
National Grasslands	3.8	4.4	36.3	2,322	612,036
NPS Lands	0.3	2.1	2.3	241	228,995

TABLE 10. DISTRIBUTION OF FENCING ON FEDERAL LANDS BY USE.

LAND CLASSIFICATION	BOUNDARY (%)	INCLUSION (%)	OTHER ¹ (%)	FENCE (mi.)	AREA (acres)
National Forest Lands	42.7	33.6	23.7	4,192	12,701,091
BLM Lands	89.7	1.1	9.2	6,751	7,733,742
Indian Lands	82.5	17.5	0.0	547	751,885
National Grasslands	75.0	18.9	6.1	2,322	612,036
NPS Lands	89.6	7.5	2.9	241	228,995

¹The major categories listed under this heading were allotment boundaries, drift fence, unit boundaries, cross fence, and administrative sites.

TABLE 11. DISTRIBUTION OF FENCING ON FEDERAL LANDS BY TYPE.

LAND CLASSIFICATION	BARBED WIRE (%)	POST & RAIL (%)	DECORATIVE WOOD (%)	OTHER ¹ (%)	TOTAL (%)
National Forest Lands	89.9	2.6	0.2	7.3	100.0
BLM Lands	89.9	0.4	0.0	9.7	100.0
Indian Lands	100.0	0.0	0.0	0.0	100.0
National Grasslands	100.0	0.0	0.0	0.0	100.0
NPS Lands	22.9	0.0	0.0	77.1	100.0

¹The major categories listed under this heading were woven wire, chain link, and buck and pole.

CHAPTER IV

DISCUSSION

Discussed in this chapter is information from previous studies and observations of various characteristics of wood posts as they relate to strength, cost, durability, maintenance, and installation.

Twenty one percent of the respondents preferred wood posts because of their superior strength. A comparison of the information in Tables 12 and 13 gives a representative picture of the many strength studies that have been conducted on posts (2, 4, 5, 8, 17).

TABLE 12. APPROXIMATE STRENGTH VALUES
OF PRESSURE-TREATED WOOD POSTS.¹

	STANDARD LINE POST	LIGHT DUTY POST	HEAVY DUTY POST
Top Diameter Size	2½" - 3½"	3½" - 4½"	4½" - 5½"
Length	6' 6"	6' 6"	6' 6"
Strength (Pounds) ²			
Northern White Cedar	400	800	1400
Pine (Pressure Creosoted)	407	970	1892
White Oak	700	1500	2700

¹Data in this table are condensed from Figure 1, Pasture and Range Fences by Michael A. McNamee and Edwin Kinne, and a sales brochure printed by Koppers Company, Inc., Pittsburgh, Pa.

²Strength is computed for a steadily applied force, 48 inches above the ground line. Wood posts will withstand higher momentary or impact loads than the table shows. The strength of most domestic species used for posts lies between the values of northern white cedar and white oak.

TABLE 13. COMPARATIVE STRENGTH OF "U" AND "T" POSTS
OF THE SAME WEIGHT AND STEEL FORMATION.¹

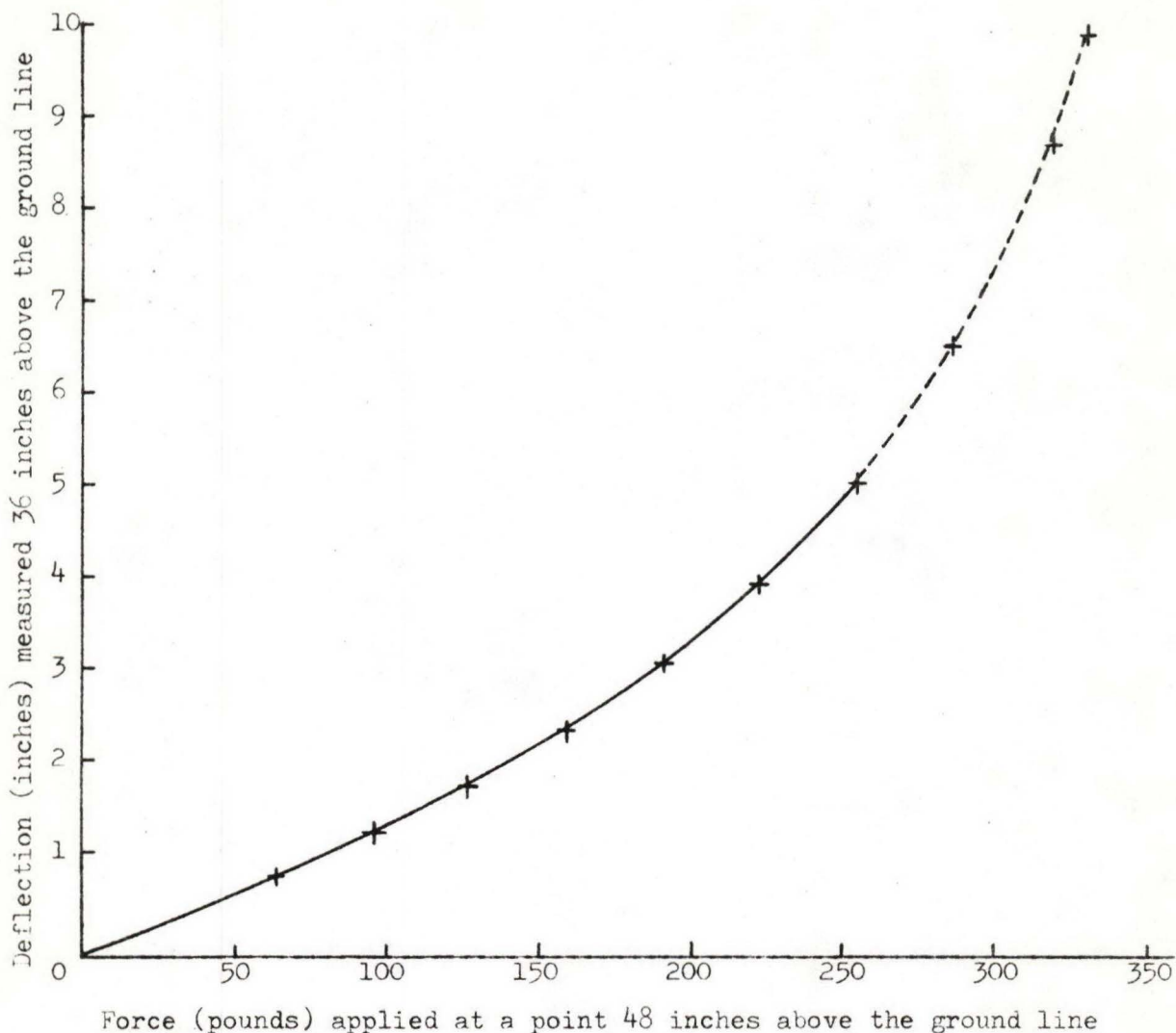
LOAD IN POUNDS	DEFLECTION IN INCHES			
	U-POSTS		T-POSTS	
	SAND	CLAY	SAND	CLAY
64	1.74	.80	3.67	4.05
89			9.53	9.29
95	3.18	1.30	failure	failure
127	4.30	1.80		
159	6.29	2.38		
191	failure	3.12		
222		4.00		
254		5.10		
286		6.60		
318		8.80		
330		failure		

¹This table was derived from Table 3, Pasture and Range Fences by Michael A. McNamee and Edwin Kinne. The load in pounds is the force applied at a point 48 inches above the ground line. The deflection was measured 36 inches above the ground line. The loads of 254, 286, 318, and 330 pounds and the corresponding deflection data were derived from Figure 1.

These tables show that a force of 330 pounds applied 48 inches above the ground line will cause the strongest commercial steel post to fail, whereas at least 400 pounds are required to cause failure of a 2½ inch wood post.

The second most common reason given for the preference of wood posts was their ability to hold in the soil. They hold in the ground better than steel simply because more surface area is in contact with the soil. This fact is supported by comments from the respondents.

"Metal posts are fine but with the snow conditions we sometimes have, snow and ice freeze to the wire, and the steel posts will settle in the ground some. They also tend to settle in soft dirt" (Craig). "In this

FIGURE 1. STRENGTH OF A STEEL "U" POST SET IN CLAY.¹

¹This curve is plotted from information given in Table 3, Pasture and Range Fences by Michael A. McNamee and Edwin Kinne.

sandy country the five-inch (split) cedar hold, and last the best of any. The steel posts just push over" (Hudson).

The third most common reason for preferring wood posts over steel was that they are less expensive. A significant percentage (5 percent), however, stated they preferred steel posts because they were less

expensive. A major reason for this is the impression that the high cost of installing wood posts makes the overall in-place cost more expensive than that for steel posts.

With the comparatively recent development of the mechanical wood post driver, studies have shown that installed wood posts are far less expensive than steel posts. In a study by Gatchell (12), the installed cost of a machine driven wood post was \$1 to \$3.25 less than that of a driven steel post.

Additional proof of the economy of pressure treated wood fence posts comes from the Lake States Forest Experiment Station (19) in which they report that preservatively treated wood posts are "the most economically obtainable". Their annual in-place cost, the U. S. Department of Agriculture research unit stated, "ranges between three and four cents [per post] compared with five cents for steel posts".

A comparative-cost study of pressure treated wood and steel guard rail posts by the Pennsylvania and Connecticut State Highway Departments, as reported by the Wood Preserving News (4), indicated these cost savings: 1) the initial purchase price of pressure creosoted wood posts was 46 percent less than that of steel posts; 2) the total installed cost of the treated guard rail posts was 20-21 percent less than for steel posts; and 3) costs per post per year for treated wood were between 40 and 46 percent less than steel.

The largest single reason for preferring steel posts was ease of installation (31 percent). Again, improvements in power driving have made the pressure treated wood post competitive with the steel post.

In the past, durability and economy have been the basic reasons for using pressure treated fence posts. To these reasons can be added

those of ease and speed of placement. Wood posts $2\frac{1}{2}$ to 9 inches in diameter and $6\frac{1}{2}$ to 8 feet in length have been power driven successfully in both wet and dry soils, in loose alluvial soils, in peat, in gravel beds, and through thick compact hardpan. They have been driven effectively in loose cultivated fields, heavy sod, among the roots of trees, on level land and on steep hillsides. A two-man crew can drive 30 to 40 posts per hour (20). Gatchell (12) concludes that wood posts can be driven on any site where steel posts can be driven. They can also be driven on some sites where steel cannot and where an auger cannot be used.

Although many farmers still build and maintain their fence by hand, the trend is to contract assignments where power driving makes the use of treated wood posts more practicable. Improvements in power driving make this the most economical way to install farm fence posts. The mounted post driver is adaptable to almost any tractor. One tractor driver and one machine operator can set $\frac{1}{2}$ mile of treated wood posts each working day. This is twice as fast as they can be installed using a tractor mounted post hole digger and then tamping around the post. A driven post is much more solid than a tamped one. Therefore it is easier to nail fencing to it. Wood posts can be driven into rocky soils that will stop a drill (1).

There are conflicting reports on whether or not machine driven wood posts should be tapered on the bottom. A forester from the U. S. Forest Service, recognized as an authority in his section of the country on the use of wood posts remarked, " . . . Personally, I wish manufacturers of power drivers would quit advertising that posts need not be sharpened. From actual experience in driving thousands of posts, I know they can be driven blunt, but they are not tight in the soil, since

there is little side compaction" (9). Quarnstrom (20) notes that just as in the case of wood piles, it is wise to sharpen the lower end of wood posts for driving into most soils.

Catchell (12) concluded that tapered posts would not be desirable. Although no tapered posts were included in his study, the posts with sloped bottoms tended to drift toward the long side. Also, as the blunt-ended posts could be rapidly driven, the cost of tapering may not be justified.

The second most common reason for preferring steel posts was ease of maintenance (19 percent). Wood Preserving News (3) reports that for highway, right-of-way, and traditional farm fences, properly treated wood posts provide designers with a sturdy, maintenance-free material that does not require painting. T. H. Rathford, maintenance engineer for the Montana Highway Department notes, "From a maintenance standpoint, we're quite pleased with the use of pressure-treated wood in signing. We have never had a wood sign post actually wear out, and . . . we've never had any deterioration of the wood to cope with as a maintenance problem in Montana" (14). Highway planners are satisfied that wood posts give the years of service required for budgetary and maintenance reasons (22).

Another major reason given for preferring steel posts was nicer appearance. This is simply a matter of personal preference. On the other hand, one of the reasons the Montana Highway Department uses wood is because of its aesthetics and natural beauty. Paul Poirier, Traffic Engineer states, "Wood posts and poles look much more natural in our rural landscape" (14).

Two other reasons commonly stated for the use of steel posts are their durability and fire resistance. Nine percent of the respondents

preferred steel posts because they were more durable and two percent because they were fire resistant. Numerous studies have reported on the durability of properly treated wood posts. Table 14 summarizes the life expectancy of various kinds of posts and gives an indication of their relative durabilities.

TABLE 14. LIFE EXPECTANCY IN YEARS OF TREATED AND UNTREATED FENCE POSTS.¹

KIND OF WOOD	UNTREATED	PRESSURE	TREATED	
			HOT & COLD BATH	COLD SOAK
Osage Orange	25-30			
Western Red Cedar	12-15	20-25	20-25	
Lodgepole Pine	2-4	20-25	15-20	10-20
Ponderosa Pine	2-4	20-25	15-20	10-20
Aspen, Cottonwood	1-3	15-20	10-15	5-10

¹From Pasture and Range Fences by Michael A. McNamee and Edwin Kinne.

Properly treated wood posts also possess a high degree of fire resistance. It is noted that creosote posts, which have been seasoned for several months after treatment, are nearly immune to damage by ordinary grass fires, and that freshly creosoted posts can withstand a severe fire test (2). In the case of untreated posts, grass fires gain entrance through pockets of decay at or near groundline. During the life expectancy of a properly treated post, there are no vulnerable spots of decay. Consequently, right-of-way and other grass fires pass without damage (20).

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

It should be recognized that fencing patterns differ because of such variables as personal preference, terrain, vegetation, climate, land use, and soil characteristics. These variables appear in different proportions and vary in their importance throughout the state.

Although lodgepole pine is the principal species for a timber treating industry in northern Colorado it would appear that there would be a demand for more treated posts if a market for the local species could be developed. In 1966, approximately 2.1 million posts (1.6 million of which were lodgepole pine) were treated in the Rocky Mountain area (See Appendix D).

Obviously, a market cannot be economically developed to utilize all the pole size trees in Colorado for fence posts. It does appear, however, that this market would substantially support integrated operations producing other wood products such as lumber, plywood, particle-board, and pulpwood.

This study shows that wood posts are competitive with steel posts in nearly all respects. The problem lies in making the consumer aware of this and educating him to the advantages of wood posts.

Additional study is needed to determine the demand characteristics of the larger consumers such as the state highway department and the railroads.

Conclusions

- (1) There are in excess of 99.6 million posts in service in Colorado.

- (2) About 81 percent of all posts in service are wood.
- (3) There are more steel posts in service on federal lands while more wood posts are being used on private farm lands. It appears this situation will continue into the future.
- (4) There is currently an annual demand for approximately 3.2 million wood posts in Colorado.
- (5) Most posts are supplied by retail suppliers. About 12 percent of all posts used by individuals are purchased from out-of-state truckers or are brought into Colorado by the consumer.
- (6) The most common treated post species in Colorado are southern yellow pine, lodgepole pine, and ponderosa pine. The most widely used untreated post species are Rocky Mountain juniper, Utah juniper, eastern redcedar, and western redcedar.
- (7) About 86.5 percent of all posts in service are either treated or made from naturally durable species.
- (8) Approximately 20 percent of the individual post users treat some or all of the posts they use. Similarly, about 20 percent cut all of their posts.
- (9) Wood posts are preferred primarily because of their superior strength, ability to hold in the soil, and lower cost.
- (10) Steel posts are preferred primarily because of the alleged ease of installation, ease of maintenance, and nicer appearance.

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A P P E N D I X

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Appendix A

COLORADO FENCE POST MARKET INFORMATION

Colorado State University

1967

National Forest _____ Date _____

-
-
1. How many miles of fencing are now in place in your National Forest?
_____ mi. (Include all types of fencing. Total fence footage or
total number of posts may be substituted if mileage is unknown).
 2. What percentage of your fencing has been installed cooperatively
with permittees? _____ %
 3. What is the common post spacing? _____ ft. (Common post spac-
ing is that used for the major portion of the fencing on your
National Forest).
 4. What percentage of your posts is: Wood? _____ %, Metal? _____ %.
Wood species _____
Indicate post treatment, if any: Creosote _____ Penta _____.
 5. What is your source of post supply?
Wood _____
Metal _____
 6. What percentage of your fencing is: Barbed-wire? _____ %
Chain link? _____ %
Post & Rail? _____ %
Decorative wood? _____ %
Other? (Indicate type) _____ %
 7. On the average, how many new posts do you use each year?
Wood _____
Metal _____
(Indicate the average number of posts used each year since 1960.
Include posts used for new fencing and those used for replacement
fencing)
 8. What percentage of your existing fencing is used as:
Boundaries? _____ %
Inclusions? _____ %
Other? (Specify) _____ %
(Boundaries are delimitations of National Forest lands or other pro-
perty within the National Forest. Inclusions indicate areas included
in smaller sections of land, such as campgrounds, etc.)

Appendix A (Continued)

9. How much of your fencing is along:

	miles	
U. S. Highways?	_____	feet
(circle proper units)		Number of posts
		% of total

	miles	
State Highways or Roads?	_____	feet
(circle proper units)		Number of posts
		% of total

	miles	
County Roads?	_____	feet
(circle proper units)		Number of posts
		% of total

Thank you very much for your cooperation.

COLORADO STATE UNIVERSITY

FORT COLLINS, COLORADO 80521

DEPARTMENT OF FOREST AND WOOD SCIENCES

October, 1967

Dear Sir:

We need your help! We are surveying a number of farm owners to help determine the market for wood fence posts, and to see if high quality wood posts can be supplied to farmers for less money.

You have been selected as one of a few to assist in this survey. Your name will not be published in connection with this survey. I assure you that your name will not appear on any mailing list as a result of this survey, nor will your name be released to anyone. If you want to be doubly sure -- don't sign your name to the questionnaire.

Please fill out the enclosed questionnaire and mail it in the self-addressed stamped envelop. If you don't know the answer to a question, please write down your best estimate.

We will greatly appreciate your help. If you wish, we will send you a copy of the results of this survey.

Sincerely yours,



Harry E. Troxell
Professor, Wood Science
and Technology

HET:di

FENCE POST QUESTIONNAIRE
WOOD UTILIZATION LABORATORY
COLORADO STATE UNIVERSITY
Fort Collins, Colorado 80521
October 1967

Please check proper spaces or fill in the proper amounts where appropriate.

My farm (ranch) acreage is ... owned _____
rented _____
total _____

My fence posts are _____ % wood and
_____ % metal.

Indicate kind(s) of wood _____

I normally use post spacing of _____ feet.

On the average, I use about _____ metal
and/or _____ wood new posts each year
for replacement.

I will add about this much new fencing in
the next five years:

_____ Miles OR _____ Feet OR _____ None

I prefer:

Only metal posts _____
Only wood posts _____
Metal posts for some jobs;
wood posts for other jobs _____

I prefer wood posts because:

Less expensive _____
Ease of installation _____
Ability to hold in the soil _____
More strength _____
Ease of maintenance _____
More durable _____
Suitability for job _____
Nicer appearance _____
State any other reasons _____

I prefer metal posts because:

Less expensive _____
Ease of installation _____
Ability to hold in the soil _____
More strength _____
Ease of maintenance _____
More durable _____
Suitability for job _____
Nicer appearance _____
State any other reasons _____

I have this much fencing on my farm (ranch):
_____ Miles OR _____ Feet

The following amount of my fencing borders
on other farms or ranches:
_____ Miles OR _____ Feet

I obtained my last wood fence posts from
(location): _____

I obtained my last metal fence posts from
(location): _____

I have this much fencing along

U. S. highways:
_____ Miles OR _____ Feet

State highways or roads:
_____ Miles OR _____ Feet

County roads:
_____ Miles OR _____ Feet

ANSWER THE FOLLOWING ONLY IF YOU USE WOOD
FENCE POSTS.

I cut my own wood posts.

All _____, Some _____ % OR None _____

I treat my own wood posts.

All _____, Some _____ % OR None _____

If answer to the treating question is yes

Preservative used: Creosote .. _____
Penta _____

Method used: Soak or Dip _____
Pressure .. _____

I use commercially-manufactured, untreated
wood posts.

All _____, Some _____ % OR None _____

I use commercially-manufactured, treated
wood posts.

All _____, Some _____ % OR None _____

My wood fence posts are _____ % treated
and _____ % untreated.

I would like a copy of the results of
this survey _____.

Name _____

Address _____

_____ (Town) _____ (Zip)

If you wish, use the back of this form for comments.

Appendix C

WOOD SPECIES USED FOR FENCE POSTS

LOCAL NAME GIVEN	PROBABLE SPECIES	REPLIES	
		NUMBER	PERCENT
<u>Untreated</u>			
cedar white cedar	Eastern or western redcedar or any of the junipers that grow in Colorado; but if juniper probably either Utah or Rocky Mountain juniper.	176	31.3
native cedar	Rocky Mountain juniper or Utah juniper.	97	17.2
Texas cedar New Mexico cedar Oklahoma cedar Missouri cedar	Eastern redcedar or Rocky Mountain, Utah, alligator, or one-seeded juniper.	37	6.6
red cedar western cedar split cedar Oregon cedar	Western redcedar.	26	4.6
untreated pine pine native pine	Ponderosa pine and lodgepole pine.	26	4.6
pitch bull pine	Ponderosa pine.	26	4.6
oak scrub oak	Gambel oak.	18	3.2
osage orange hedge catalpa	Osage orange.	11	2.0
<u>Treated</u>			
treated pine "treated" treated southern pine penta-treated lodgepole pine hard pine Idahopine pine	Southern yellow pine with some lodgepole pine and pon- derosa pine.	103	18.3

Appendix C (Continued)

LOCAL NAME GIVEN	PROBABLE SPECIES	REPLIES	
		NUMBER	PERCENT
railroad ties	Red oak or other hardwoods, Douglas fir, lodgepole pine or ponderosa pine.	20	3.5
spruce treated spruce red spruce fir	Douglas fir.	12	2.1
<u>Miscellaneous</u>			
pinion		3	
aspen		3	
locust		1	
cypress		1	
bristlecone pine		1	
redwood		1	
split telephone poles		1	2.0

Appendix D

FENCE POSTS TREATED IN THE UNITED STATES DURING 1966¹

Preservative Used

	Thousand Posts
Creosote and creosote-coal tar	13,763
Petroleum-pentachlorophenol	13,760
Creosote-petroleum	3,659
Osmosalts	173
Tanalith	169
All other	<u>1,082</u>
Total	32,606

Species

Southern pine	28,446
Lodgepole pine	1,613
Ponderosa pine	553
Norway pine	149
Douglas fir	39
All other and mixed	<u>1,806</u>
Total	32,606

Region

Northeast	430
North Central	4,320
Southeast	7,726
South Central	17,907
Rocky Mountain	2,128
Pacific	<u>95</u>
Total	32,606

¹See reference (13).